TWIN MOTOR DRIVE SYSTEM FOR HYBRID ELECTRIC VEHICLE

FIELD

[0001] The present description relates generally to methods and systems for hybrid electric vehicles including a front-wheel drive system and a rear-wheel drive system.

BACKGROUND/SUMMARY

[0002] A motorized vehicle may include an all-wheel drive system configured to provide torque to wheels positioned at each end of the vehicle. The all-wheel drive system may increase wheel traction with a ground surface on which the vehicle sits to increase acceleration and decrease wheel slippage. In some examples, each wheel may be driven by an internal combustion engine of the vehicle. In order to drive each wheel, torque produced by the engine may be received by a transmission of the vehicle. An output of the transmission is coupled to a transfer case in order to provide the torque to one or more drive shafts coupled to the transfer case. However, in vehicles having a smaller amount of space for drivetrain components, packaging the components of an all-wheel drive system may be difficult. As a result, some vehicles may include wheels driven by a different type of motor, such as an electric motor.

[0003] One example approach of an all-wheel drive system is shown by Plishner in U.S. Pat. No. 6,880,654. Therein, a motorized vehicle is disclosed having a distributed motor system with a plurality of electric drive motors each coupled to a respective traction wheel. Each electric drive motor, steering motor, and wheel positioning motor may be integrated into a wheel manipulator element, and the wheel manipulator element may provide signals indicating the motion of the wheels to a controller of the vehicle.

[0004] Another example approach is shown by Thomas et al. in U.S. Pat. No. 7,384,357. Therein, a hybrid powertrain for a four-wheel drive vehicle is disclosed. The vehicle includes a front wheel drive system having front half shafts driveably connected to front wheels and driven by an electric motor drive unit. The powertrain also includes a rear wheel drive system having rear axle shafts driveably connected to rear wheels, the rear axle shafts driven by an internal combustion engine through a transmission, a drive shaft, and an inter-wheel differential mechanism.

[0005] However, the inventors herein have recognized potential issues with such systems. As one example, an electric motor configured to drive both front wheels of a vehicle, together, as described by the '357 patent may occupy a relatively larger amount of space. The electric motor in this configuration may not be suitable for vehicles having an internal combustion engine mounted in a longitudinal arrangement within the vehicle, such as a V-engine with cylinder banks positioned opposite to each other across a longitudinal axis of the vehicle. Such engine arrangements may not include an amount of space within the engine compartment to house the electric motor. As another example, a distributed motor system with different electric motors coupled to each wheel of a vehicle, such as that described by the '654 patent, may consume larger amounts of electrical energy in order to power the drivetrain of the vehicle. The larger amounts of electrical energy consumed may require electrical components (e.g., batteries, generators, etc.) with an increased size, complexity, and/or cost, and the electrical components may be difficult to maintain and/or repair.

[0006] In one example, the issues described above may be addressed by a system, comprising: a longitudinally mounted engine adapted to drive rear wheels of a vehicle; and two, independent, electric motors mounted to the engine, on opposite sides of the engine, and adapted to drive front wheels of the vehicle, where the two electric motors are not rotationally coupled to the engine. In this way, the engine may provide torque to the rear wheels of the engine, and the front wheels may be driven independently from the rear wheels by the two electric motors.

[0007] As one example, each of the two electric motors may be a pancake motor, with a diameter of each electric motor being greater than a width of each electric motor. The electric motors may be mounted directly to an oil pan of the engine and opposite to each other relative to a longitudinal axis of the engine. Each electric motor may be directly coupled to different reduction gearboxes in order to provide a torque output of each electric motor to front wheel axles of the vehicle. The engine may further include an integrated starter motor/generator configured to supply electrical power to the electric motors, with the starter motor/generator receiving torque from a crankshaft of the engine. By coupling the electric motors directly to the oil pan of the engine, an amount of space occupied by the electric motors within the vehicle may be reduced, and the electric motors may be selectively energized in order to drive the front wheels independently of the rear wheels. Additionally, by supplying electrical power to the electric motors via the integrated starter/generator, an electrical load on one or more batteries of the vehicle may be reduced during conditions such as engine idling.

[0008] It should be understood that the summary above is provided to introduce in simplified form a selection of concepts that are further described in the detailed description. It is not meant to identify key or essential features of the claimed subject matter, the scope of which is defined uniquely by the claims that follow the detailed description. Furthermore, the claimed subject matter is not limited to implementations that solve any disadvantages noted above or in any part of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** shows a schematic diagram of an engine system including front wheels driven by electric motors.

[0010] FIG. **2** shows a schematic diagram of a vehicle including the engine system of FIG. **1**.

[0011] FIG. **3** shows a perspective view of an engine system including a first electric motor coupled to a first side of an engine and a second electric motor coupled to a second side of the engine.

[0012] FIG. **4** shows a second perspective view of the engine system shown by FIG. **3**.

[0013] FIG. **5** shows a third perspective view of the engine system shown by FIGS. **3-4** and shows the first electric motor coupled to a first engine mount.

[0014] FIG. **6** shows a side view of the engine system shown by FIGS. **3-5** with the first electric motor coupled to the first engine mount.

[0015] FIG. **7** shows a bottom view of the engine system shown by FIGS. **3-6**.